AL-Fateh University Faculty of Engineering Electrical and Electronic Eng Department

Fall 2010 – Final Exam Solution **Signals & System (EE302)** Date: 18/01/2011 Time: 3hrs

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Q1)A) Choose the right answer:

1)The Laplace Transform is used in the analysis of a) Continuous time systems

2)The term **BIBO** for stable systems means d) Bounded Input Bounded Output

3)Analog signals **a)**Is one that is defined over a continuum of values of time.

4)If the system is unstable, then its transfer function must have a)at least one pole in the right half of the S - plane .

5) A system is time-invariant if a time shift in the input signal causes a a) a time shift in the output signal

6) Many linear systems requirements are specified in terms of a) frequency response

7) The Fourier transform of the unit impulse $\delta(t)$ is a) 1

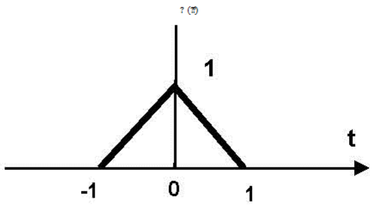
8) The Laplace transform of the unit step u(t) is b) 1/s

Q1)B) Answer the following question

a)G(f)=FT(g(t))

c) $v(t) = \Pi(t) * \Pi(t) = \Lambda(t)$

$$\Lambda(t) = \begin{cases} 1-|t| & |t| \le 1.0 \\ 0 & |t| > 1.0 \end{cases}$$



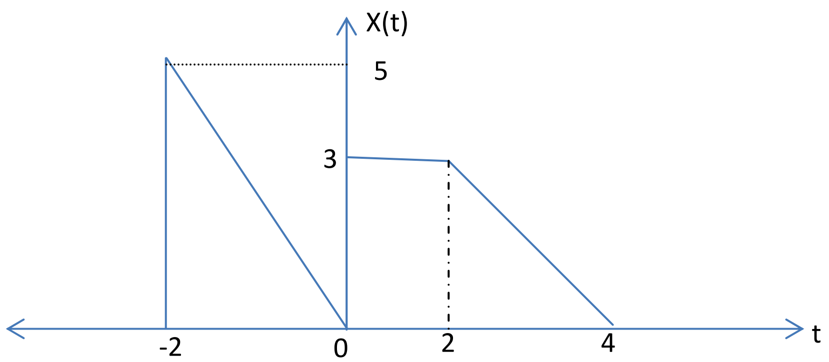
Q2)C)

a)Poles :P1= 2 , P2= -1+j P3=-1-j

b)Zeros: Z1= 0 , Z2=1 , Z3= -2

c) The systems is …Unstable…….because its H(s) has one pole in the RH of the S-plane..

Q2)



Q3)

a)Fourier theory states that a periodic signals can be decomposed into the sum of a series of harmonically related sinusoidals of appropriate amplitude and phases. The periodic signals can then be described by the spectrum of discrete amplitudes & phase values- a line spectrum.

b) i) Dc component =0

ii) sine components

iii) infinite

C) by adding the fifth signal with the first signal we get the wanted signal

$$v(t) = \frac{8}{\pi^2}\sum_{n=1}^{\infty}\frac{(-1)^{n+1}}{(2n-1)^2}\sin 2\pi\left(\frac{2n-1}{T}\right)t + \frac{4}{\pi}\sum_{n=1}^{\infty}\frac{1}{2n-1}\sin 2\pi\left(\frac{2n-1}{T}\right)t$$

Dc Term (a_o)=o for n=1 & 2

$$v(t) = \frac{8}{\pi^2}\left\{\sin 2\pi ft - \frac{1}{3}\sin 2\,\pi\; 3ft\right\} + \frac{4}{\pi}\left\{\sin 2\pi ft + \frac{1}{3}\sin 2\pi\; 3ft\right\}$$

Where f=1HZ

Q – Find the impulse response of the continuous time systems defined by the following differential equation

$$(D^2 - D - 6)\left[y(t)\right] = 5x(t)$$

$$h(t) = \left[c_1 e^{3t} + c_2 e^{-2t}\right]u(t) \qquad h(0) = 0, \qquad h'(0) = 5$$

$$h(t) = \left[e^{3t} - e^{-2t}\right]u(t)$$

Q – A discrete LTI system with input sequence $\{x(k)\} = \{1\}$ and output sequence

$\{y(k)\} = \{0,0,1,-2,-3,1\}$.

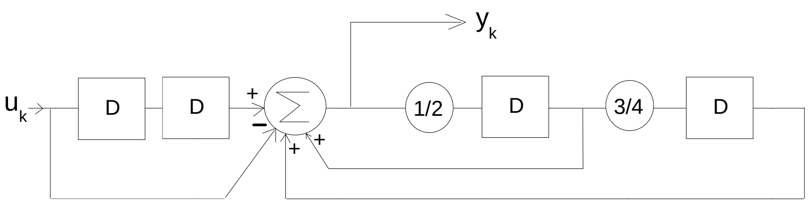
a) Find the impulse response of the system.
b) Find the output of the same system when $\{x(k)\} = \{-2,1\}$.

Solution

a) $h_k = \{0,0,1,-2,-3,1\}$

b) $y_k = x * h = \{0,0,1,-2,-3,1\} * \{-2,1\} = \{0,0,-2,5,4,-5,1\}$

Q - Find the frequency-response of the following discrete time system



Solution

$$y_k - \frac{1}{2}y_{k-1} - \frac{3}{8}y_{k-2} = x_{k-2} - x_k$$

$$H(e^{j\theta}) = \frac{-1 + e^{-2j\theta}}{1 - \frac{1}{2}e^{-j\theta} - \frac{3}{8}e^{-2j\theta}}$$

Q – Sketch a block diagram of a system whose impulse response sequence is

$$h_k = 36\left(\frac{1}{5}\right)^k - 30\left(\frac{1}{6}\right)^k \qquad k \geq 0$$

Sol: $$\left(r - \tfrac{1}{5}\right)\left(r - \tfrac{1}{6}\right) \rightarrow r^2 - \tfrac{11}{30}r + \tfrac{1}{30} = 0 \qquad h_0 = 6$$

$$y_k - \tfrac{11}{30}y_{k-1} + \tfrac{1}{30}y_{k-2} = 6x_k$$